Lesson no. 34 Memecylon (Warss)

Memecylon is a big group of plants from Melastomataceae family. It consists of 350-400 species of small to medium-sized trees and shrubs occurring in the Old World tropics. Memecylon is a monophyletic group basal to the Melastomataceae clade. Memecylon taxa have more than 600 published basionyms. Diversity of this group is concentrated in tropical Africa, Madagascar, Sri Lanka, India and Malaysia. The name *Memecylon* is derived from memaecylon' as used by ancient Greek philosophers (Pedanius Dioscorides was a Greek physician, pharmacologist, botanist). Memecylon is identified by these characters exstipulate leaves, four-merous bisexual flowers, anthers opening by slits, enlarged connectives bearing terpenoid secreting glands and berries. Memecylon can be distinguished from other Memecyloids by obscure nervation on leaves, non-glandular roughened leaf surface having branched sclerids, imbricate calyx, unilocular ovary and large embryo with thick and convoluted cotyledons. The genus *Memecylon* is associated closely to *Syzygium* R. Br. It is difficult to identify memecylon spices due to similarity with other types of plants; & as there are many types of memecylon plants & amongst its which is warss (mentioned in hadith) need to be researched; many scholars advise that Memecylon tinctorium is warss which is mentioned in hadith; but we need to research it properly to known.

It is mentioned in many books of Hadith as Prophet Muhammad (s.a.w) advised warss (memecylon) to be used for pleurisy (a pulmonary disease) along with Qust (costus) & olive oil; in other hadith warss (memecylon) & olive oil for treatment of pleurisy as to be kept in one corner of mouth the side which is suffering; also in other hadith it is mentioned to use with Qustuluhind (dark costus) for throat infections; it was used for skin freckles.

For detail Islamic study on warss (memecyclon) please read my English book Tibb e Nabawi part 2 lesson 55, page 172 onwards; or visit my website www.tib-e-nabi-for-you.com or direct link to lesson warss on my website http://www.tib-e-nabi-for-you.com/warss.html

- **NAMES: -**

1. In Hadees it is called as Warss (ورس).
2. In Persian it is called as Karkam.

3. In Latin it is called as Memecylon tinctorium.
4. In English it is called as Memecylon or Blue mist plant.
5. In Marathi it is called as Graham.
6. It belongs to Melastomataceae family.
7. In Hindi it is called as Anjan.
8. In Malayalam it is called as Aattukanala.
9. In Oriya it is called as Neymaru.

It is mentioned in following books of Hadith (names of book of Hadith & reference are also given): -
Tirmizi : 2222; Ibn Majah : 3596, 692, 693; An-Nasai : 2666; Abu Dawud : 4210; Mustadrak Hakim : 8239.

- ***Basic encyclopedia of warss (memecylon): -***
- ***Memecylon plant: -***

We are learning the encyclopedia of memecylon spices. Memecylon can be identified by its these characters as there as many similar looking plant; exstipulate (leaves without stipules) leaves, its flower has four-merous & is bisexual flowers, anthers opening by slits, enlarged connectives bearing terpenoid secreting glands & berries.

Memecylon can be distinguished from other Memecyloids by obscure nervation on leaves, non-glandular roughened leaf surface having branched sclerids, imbricate calyx, unilocular ovary and large embryo with thick and convoluted cotyledons.

The dense and axillary showy clusters of Memecylon florets do not produce nectar. These flowers are visited by pollen-gathering bees that vibrate or manipulate the anthers. Anthers open by longitudinal slits and exposed pollen invites pollen gathering bees. Anther appendages serve as a hold for bees' legs. These flowers have terpenoid secreting glands and bees collect terpenoids. Therefore, buzz pollination is also favored. Berries are dispersed by birds and mammals. Populations of Memecylon are widely scattered within the forests as would be expected in bird-dispersed species.

Memecylon produce flowers and fruits more regularly than many trees of the equatorial forests. It provides a food supply for wildlife as a source of fruits.

- ***Stems: -***


Species of larger stature have a characteristic brown bark with narrow and sharp furrows, most are small single stemmed trees. However, the bark of many species of smaller stature is varied and may be papery white or smooth dark red black. It provides hard and valuable timber used for building houses and boats. Its wood is used to make rafters, house posts, fuel wood, charcoal, tools, and handles. The bark is applied as a poultice to bruises. Root and heartwood decoctions are used to bring down fever associated with colds, chicken pox and measles.

- ***Leaves: -***


Leaves are opposite, short-stalked, elliptic or ovate, mostly with widely spaced pinnate nerves either visible or obscure. Leaves along the twig are all the same size, shiny, glabrous, with entire margins, the node has a characteristic scar between the leaves and twig bark is typically red, striated and flaky. A yellow dye and a mordant can be extracted from the leaves. An infusion of leaves is used as astringent for ophthalmia. Leaves are used in the treatment of gonorrhea, or when mixed with several other ingredients, they make good formulations for external use.

- ***Flowers: -***

The inflorescence is typically dense and axillary. The florets are small (usually less than 5 mm) compared to the other taxa in Melastomataceae, with short fleshy corolla parts. Cymes are bracteate, usually thyrsoid to umbel shaped, often condensed to sessile fascicles of flowers or a few-flowered heads at tips of peduncles. The florets are white or violet, the stamens blue or violet, usually obvious in aggregates, from axillary clusters. Flowers are bisexual, have inferior ovaries, but the parts are otherwise free. The calyx is valvate and there are twice as many stamens as petals.

- ***Fruits: -***

The fruit is from an inferior ovary, typically axillary. The calyx remnants are persistent, and are sometimes blue-black. Fruits are globose or occasionally ellipsoid, pulpy or juicy with one large seed. Fruits are edible and some are used as spices.

- ***pH of it is: -*** Not known as it is taken in minor medicinal doses only.
- ***Calories of it: -*** Not known as it is taken in minor medicinal doses only.
- ***Glycemic index & Glycemic load of it: -*** Not known as it is taken in minor medicinal doses only.
- ***Gross health benefits of : -***

In Ayurveda and Siddha, several *Memecylon* species are reported to be used by tribals in the treatment of skin disorders, stomach disorders, herpes, chickenpox, leucorrhoea, polyuria, menorrhagia, dysentery and also in the treatment of bacterial infections and inflammation.

M. umbellatum leaves are used to treat snake bite, given orally or in the form of infusion. Ethno-medically fruit of ***M. malabaricum*** is used to control sterility in men, and the leaf juice of ***M. capitellatum*** is taken internally for a month to treat diabetes. The leaves of other *Memecylon* species namely *M. lushingtonii* are effective in the post-citoal contraceptive. The bark of ***M. angustifolium*** is used as a tonic and refrigerant. Apart from medicinal uses, *Memecylon* species are used as ornamentals, decorative plant work, walking sticks, light axe handles, combs, timbers, yellow dye and in combination with myrobalans and sappan wood produces bright red tinge, astringent ripe berries are eaten at the time of famine worldwide and also as a mordant in silk dyeing industries.

- ***Clinical pharmacology of : -***

Pharmacological potential of *Memecylon* species

Antidiabetic activity: -

The oral administration of alcoholic extracts of the leaves of *M. umbellatum* led to a significant lowering of serum glucose level in normal and alloxan-induced diabetic mice. The result indicated the *M. umbellatum* has interesting possibilities as a source of oral hypoglycemic agent. Methanolic extract of *M. malabaricum* also showed a similar effect when compared to standard reference gliclazide. The acute toxicity studies of *M. umbellatum* revealed no side effect on the liver and kidney as evident by the significant reduction in urea and creatinine level as compared to diabetic control. The chronic studies confirmed a gain in body weight of the extract administered rats. Antidiabetic and anti-hyperglycemic potential of *M. umbellatum* were analysed for different solvent extracts like hexane, ethyl acetate, and methanol. Inhibition of α-amylase, non-enzymatic glycosylation of hemoglobin, the glucose diffusion assay and the glucose uptake by the yeast cells were used to evaluate antidiabetic potential. Methanol extracts showed higher antidiabetic activity. In glucose diffusion assay significant inhibition of glucose movement at various time intervals was observed when compared to control.

The administration of oral doses of *M. talbotianum* leaf methanol extract (MTLME) decreases the glucose level after four weeks in diabetic animals in MTLME treated animals along with controlling the levels of TG in diabetic and in treated animals and endogenous antioxidants including SOD, Catalase and GSH. Histopathological and immune-histological studies of the pancreas showed the protective effect of MTLME extract on intraoral administration.

Anti-inflammatory activity: -

The alcoholic leaf extract of *M. umbellatum* was examined for wound healing potential in the form of ointment (0.5, 1.0 and 2% w/w), the excision and the incision wound model in rats. The extract induced a significant response in both the wound models as compared to the standard drug nitrofurazone ointment (0.2%w/w). The ethanolic extract of *M. umbellatum* was evaluated for anti-inflammatory activity using acute rat model by carrageenan induced rat paw edema and a sub-acute rat model by cotton pellet induced granuloma. The extract showed significant anti-inflammatory activity in both the animal models and the weight of adrenal glands were also found to be significantly increased in extract treated animals. The results show the dose-dependent anti-inflammatory activity.

The anti-inflammatory activities of the leaves of *M. edule* were determined for different solvent extracts such as hexane, ethyl acetate, methanol, and ethanol. The most active fraction was further tested *in vivo* for its anti-inflammatory activity using the ethyl phenyl propiolate (EPP)-induced mouse ear edema and the writhing test in mice administrated orally 200 mg/kg of ethyl acetate (EtOAc) caused a significant inhibition of the writhing response by 56.6%.

Memecylaene, a novel compound isolated from *M. malabaricum* and this compound was tested for anti-inflammatory activity in albino rats in acute and sub-acute animal models. Analysis of biochemical parameters, such as antioxidant enzyme activities from granuloma, lipid peroxidation inhibition in the liver of granuloma induced rats, as well as mucopolysaccharides from the granuloma was carried out. Memecylaene treatment significantly increased the antioxidant enzyme activities (CAT, SOD and GPx ($P<0.05$). Inhibition of lipid peroxides in liver and mucopolysaccharides in granuloma tissue. The anti-inflammatory activity of Memecylaene showed in both the models of inflammation which is attributed to their antioxidant and phospholipase A2 inhibitory activities. Thus, the study validated the scientific rationale of ethno-medicinal use of *M. malabaricum* to inflammatory associated diseases and unveils its mechanism of action.

Different solvent extracts of *M. talbotianum* were evaluated for anti-inflammatory properties. Methanol extract exhibited highest inhibition for xanthine oxidase (IC50 12.56 mg/ml) and 15-lipoxygenase (IC50 1 mg/ml). *In vitro* antispasmodic activity was evaluated using ethanol plant extract of the *M. umbellatum* using rat ileum. The extract at a concentration of 50, 100, and 200 mg exhibited inhibition respectively, against acetylcholine-induced contraction in isolated rat ileum preparation. The antispasmodic activity may be due to its cholinergic system blockade. This study reveals that the extract antagonizes the contraction in ileum stimulated by acetylcholine, indicates that the extract shows atropine-like action. Dhar *et al.* reported that the crude plant extract of *M. umbellatum* had anti-amphetamine and spasmolytic activity against Ranikhet disease virus.

Antioxidant activity: -

The methanol extract of *M. umbellatum* leaf was evaluated for *in vitro* antioxidant activity and *in vivo* antinociceptive effect in acetic acid induced writhing model in Swiss albino mice. The plant extract was also subjected for brine shrimp lethality bioassay to evaluate its cytotoxic property. The results revealed the antioxidant property as compared with the ascorbic acid used as standard and a dose-dependent (250 and 500 mg/kg) analgesic effect. The investigation also showed that it has strong lethality (LC50 1.178 µg/ml) against brine shrimp nauplii compared with vincristine sulphate used as positive control. The antioxidant, antinociceptive and cytotoxic properties support the traditional uses of *M. umbellatum*.

The antioxidant activities of the solvent extract of the leaves of *M. edule* were determined by different solvent extracts such as hexane, ethyl acetate, methanol and ethanol of the dry leaves were tested *in vitro* for their interleukin-10 production. At 200 mg/kg orally, the EtOAc caused a significant inhibition of the writhing response by 56.6% which was like indomethacin at 10 mg/kg. EtOAc, MeOH and MeOH50 exhibited radical scavenging activity.

Different solvent extracts of *M. talbotianum* was evaluated for antioxidant properties. Methanol extract exhibited with greater reactive oxygen species scavenging activity, DPPH, ABTS, superoxide radical scavenging activity (SRSA) and reducing power properties reported.

M. terminale plant extracts were screened for antioxidant properties. The methanol extract showed a dose-dependent antioxidant activity [38]. The methanolic extracts of leaves of 32 *Memecylon* species collected from the Western Ghats were evaluated for pharmacological evaluation. The highest antioxidant activity was observed for *M. heyneanum*.

Hepatoprotective activity: -

The hepatoprotective effect of *M. umbellatum* roots against acetaminophen induced hepatotoxicity in rats was evaluated. An oral dose of 200 or 400 mg/kg produced significant hepatoprotection by reducing elevated levels of serum enzymes and restored normal histological features of the liver, when compared to the control group. The leaf extracts of *M. umbellatum* also showed significant hepatoprotective activity. Pretreatment of rats with the root extract exhibited marked protection against carbon tetrachloride hepatotoxicity. The results showed that the extracts decreased the level of SGOT, SGPT, ALP, γ-GT and bilirubin at the dose of 400 mg/kg, comparable to standard drug silymarin. The result also showed that the ethanolic extract treated groups have significantly shorten the thiopental sleeping time in rats as compared to animals receiving CCl4 alone.

Nephroprotective activity: -

Ethanol extract of *M. umbellatum* root was investigated for nephroprotective activity against cisplatin-induced acute renal damage in rats. The extracts at 100 to 400 mg/kg body weight showed a dose-dependent reduction in elevated blood urea, serum creatinine and also normalized the histopathological changes in the curative regimen. These findings suggest that the apparent system of nephro protection by *M. umbellatum*.

Analgesic activity: -

The ethanol extract of *M. umbellatum* root was evaluated for its central and peripheral analgesic activity in tail-flick, hot plate and acetic acid induced writhing models. The plant extract showed more prominent peripheral effect than the central effect. The analgesic activities of the solvent leaf extract of *M. edule* was determined by the ethanol extract showed interleukin-10 production. *M. terminale* plant extracts were screened for analgesic and RBC protective activity. The results showed a dose dependent activity. The ethanol extract of *M. umbellatum* was evaluated for anti-pyretic activity in yeast induced pyrexia model in rats. A dose dependent reduction in yeast induced hyperpyrexia was observed in rats when compared to the standard drug paracetamol.

Anti-helmintic activity: -

Aqueous and ethanol leaf extracts of *M. malabaricum* were evaluated for their anti-helmintic activity against *Pheritima posthuma* which involved the determination of time of paralysis and time of death of the worms. Both the extracts exhibited highly significant anti-helmintic activity at the highest concentration of 60 mg/ml. Piperazine citrate was included as the standard reference and normal saline as control.

Anticancer activity: -

Apoptogenic and anti-proliferative activity of ethyl acetate extract of *M. edule* leaves (EtAc-LME) in gastric cancer cell lines and non-cancerous gastric mucous cells, and the mechanism of EtAc-LME induced apoptosis was determined by analysing the activation of pro-caspases, PARP cleavage, expression of cytochrome-c (Cyt-c) by western blotting, mRNA expression of Bcl-2, Bax by RT-PCR, loss of mitochondrial potential using DiOC6 dye, annexin binding assay and its influence on cell cycle arrest by flow cytometry. The results showed that EtAc-LME inhibited the gastric cancer cell growth in dose-dependent manner and cytotoxicity was more towards the gastric cancer cells (NUGC and MKN-74) compared to normal gastric cells (GES-1), suggesting more specific cytotoxicity to the malignant cells. Over expression of Cyt-c and subsequent activation of caspases-3 and down regulation of Bcl-2 and loss in mitochondrial potential in EtAc-LME treated MKN-74 and NUGC cells suggested that EtAc-LME induced apoptosis by mitochondrial dependent pathway. Hence the study suggests that ethyl acetate extract of *M. edule* induces apoptosis selectively in gastric cancer cells emphasizing the importance of this traditional medicine in the treatment of gastric cancer.

Antimicrobial activity: -

Alcoholic extract of *M. umbellatum* was evaluated for its antimicrobial activity, and the study showed maximum antibacterial activity against *Staphylococcus aureus* (Gram positive) and it also showed antibacterial activity against Gram-negative bacteria, and also alcoholic extract alone showed slight antifungal activity. Different solvent extracts were screened for antimicrobial activity using both polar and nonpolar solvents among all the extracts ethyl acetate, and methanol extracts of seed and leaves have shown activities when compared to other extracts. The petroleum ether, chloroform, and ethanol leaf extract showed concentration-dependent activity against all the tested bacteria with zone of inhibition at various concentrations.

Memecylon edule methanol extracts were investigated against Gram-positive (*Staphylococcus aureus, Staphylococcus epidermidis*, *Micrococcus luteus* and *Bacillus cereus*) and Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Kelebsiella pneumonia*) and fungi such as *Aspergillus niger*, *A. fumigatus* and *Candida albicans* by disc diffusion method. Antimicrobial studies revealed that both the extracts have significant activity against gram-positive, gram-negative bacteria and fungus. Chloroform and ethyl acetate seed extracts showed moderate antibacterial activity and secondary metabolites of this plant used for wound healing property and other forms of bacterial infections. Ethyl acetate extract showed antibacterial and antifungal activity against *Salmonella typhimurium* and *S. pneumonia* and Vivek reported the antimicrobial activity of methanol extracts of *M. malabaricum*, *M. talbotianum*, *M. edule*, *M. umbellatum* and *M. wightii* leaves against both Gram-positive and Gram-negative bacteria and fungi.

The antibacterial activity of *M. talbotianum* was determined against human pathogens through disc diffusion, (MIC), (MBIC) test as visualized by Alamar blue and confocal laser scanning microscopy. (MIC for Gram-positive bacteria 54 µg/ml). The bacterial cells were lysed at 24 h incubation resulting in nearly a 4 log10 CFU/ml drop in cell viability at 1.6 X MIC for the methanol plant extract. The extract at two-fold MIC inhibited the bacterial biofilm formation and at 8 fold MIC eradicated the biofilm. The extract was less effective on Gram-negative bacteria.

Memecylon terminale plant extracts were screened for antibacterial activity; results showed a dose-dependent antibacterial activity against different Gram-positive and Gram-negative bacterial strains. The methanolic extracts of leaves of 32 *Memecylon* species were evaluated for antibacterial activity, and a broad spectrum of antibacterial activity was observed in *M. clarkeanum* and *M. sessile*.

Genotoxic studies: -

The antigenicity studies of *M. umbellatum* alcoholic leaf extracts were carried out against cyclophosphamide-induced chromosomal aberration and micronucleus formation. The results showed that these extracts had prevented the geno-toxicity of cyclophosphamide. The frequency of chromosomal aberration and micronucleus (MN) although not significant statistically, the percentage aberration and MN formation appeared to be dose and time dependent. There was a slight depression in the mitotic index compared to negative controls. Thus, the extracts were found to be non-mutagenic on bone marrow cells of mice. The anti-genocity studies are directly related to the protective role of the extracts on the genetic material.

Tissue engineering studies: -

Electro-spinning studies were carried out for skin tissue engineering in four different plant extracts namely *Indigofera aspalathoides*, *Azadirachta indica*, *Memecylon edule (ME)* and *Myristica andamanica* along with a biodegradable polymer, polycaprolactone (PCL). The ability of human dermal fibroblasts (HDF) to proliferate on the electro-spun nanofibrous scaffolds was evaluated via cell proliferation assay. HDF proliferation on PCL/ME nanofibers was found the highest among all the other electro-spun nanofibrous scaffolds, and it was 31% higher than the proliferation on PCL nanofibers after 9 d of cell culture. The interaction of HDF with the electro-spun scaffold was studied by F-actin and collagen staining studies. The results confirmed that PCL/ME had the least cytotoxicity among the different plant extract containing scaffolds studied here. Early and intermediate epidermal differentiation of adipose derived stem cells was performed on PCL/ME scaffolds. The study demonstrated the potential of electro-spun PCL/ME nanofibers as substrates for skin tissue engineering.

- ***Modern uses of it: -***

For pain & swelling: -

Take root powder of memecylon umbellatum half teaspoon & mix it in extra virgin olive oil prepare a paste & lick it 3 time day & drink 1cup water on it; for 21 days followed by twice a day for 21 days followed by once a day for 11 days.

For throat infection: -

Take leave powder of memecylon umbellatum half teaspoon, half tea spoon of Qustul Bahri or Qustul-hind mix in little extra virgin olive oil & prepare a paste lick it & drink 1 cup of water on it for 3 times a day for 11 days followed by twice a day for 11 days followed by once a day for 11 days.

For general health or to maintain health: -

Take 1 teaspoon of memecyclon umbellatum, 1 teaspoon of senna powder, 7 seeds of black caraway, 7 seeds of fenugreek seeds all on little extra virgin olive oil for 3 hours & add 1 spoon honey mix all to prepare a paste lick this paste & drink 1 cup water on it, once a week early morning empty stomach lifelong.

- ***Contents/constituents of***

All contents may not present in all types of it, because there are many varieties of it according to geographical regions & content may differ a lot as per cultivation, soil, seed, climate etc.

Common types of memecyclon & their constituents: -

Table 2: Chemical constituents of *Memecylon* species and their mechanism of action

S. No.	Plant name	Part used	Chemical group	Compound name	Pharmacological activity	Mechanism of action
1	*M. umbellatum*	Leaf	Ketone	Umbelactone	Antioxidant, radical scavenging, antibacterial, antimutagen, and anticarcinogen	----------
			Triterpenes	Amyrin, ursolic acid	Inflammation, viral infections, cancer, and diabetes	Inhibition of NF-kB and CREB activation. Ursolic acid is been shown to inhibit JNK expression and IL-2 activation of JURKAT leukemic T cells leading to the reduction in proliferation and T cell activation.
			Lipid	Sitosterol	Heart diseases, cancer, HIV, rheumatoid arthritis, psoriasis, allergies	Inhibit the production of carcinogens, cancer-cell growth, invasion, and metastasis, and promote apoptosis of cancerous cells (Meric *et al.*2006).
			Fatty acids	octacosanoic acid, cerotic acid, ethyl palmitate, palmitic acid and butyric acid	multiple sclerosis, diabetes, fibromyalgia, myocardial ischemia	Suppress the transfer of glucose from the stomach to the small intestine and by inhibiting glucose transport at the brush border of the small intestine. Inhibition of proinflammatory cytokines and chemokines, and stimulation of anti-inflammatory ones.
2	*M.*	Leaf	Flavonoids	Apigenin	Cancer, inflammation, diabetes	Increase the intracellular concentration

	talbotianum		Luteolin Quercetin Kaempferol Rutin Isorhamnetin		of glutathione, enhancing the endogenous defense against oxidative stress. Strong inhibitor of ornithine decarboxylase, an enzyme that plays a major role in tumor promotion.
		Phenolics	Gallic acid, Protocatechuic acid, feruloyl quinic acid, Catechins	Neurodegenerative diseases, Diabetic complication, inflammation, helminthic and skin diseases.	By modifying the properties of alpha-synuclein, a protein associated with neurodegenerative diseases. By decreasing the expression of proapoptotic genes (*bax, bad*, *caspase-1* and cyclin-dependent kinase inhibitor). Improve activity of catalase and SOD.
		Organic acids	Cinnamic acid, Sinapic acid, Ferulic acid.	Chagas' disease, cancer, atherosclerosis, liver and kidney disorders and diabetes	Sinapic acid has been described as chain-breaking antioxidants that probably act as radical scavengers. This function is related to their hydrogen atom donating ability and their ability to stabilize the resulting phenoxyl radicals via the conjugated system comprising the arene and the alkenyl carboxylate side chain. Decrease lipid peroxidation and enhance the level of glutathione and antioxidant enzyme levels.

3	*M. caeruleum* *M. amplexicaule*	Anthocyanin	Mv-3,5-diglucoside Cy-3,5-diglucoside	Cardiovascular disorders	Inhibitory effects on proapoptotic and cardioregulatory genes. Modulating apoptotic regulatory bcl-XL, p53 and c-myc genes.
4	*M. malabaricum*	Leaf	4,9,14,19-Tetramethyl-1,6,11,16-tetraoxacycloeicos-3,8,13,19-tetraene (Memecylaene)	Inflammation and allergic disorders	unknown
5	*M. edule*	Leaf	Triterpenes, tannins, and flavonoids	unknown	unknown	unknown
6	*M. tinctorium*	*Leaf, fruit.*		*unknown*	*unknown*

- ***Phytochemistry: -***

Phytochemical analysis of chloroform and ethyl acetate seed extracts of *M. edule* revealed the presence of Alkaloids, triterpenes, flavonoids and saponin. The tannin content was found highest in bark than in leaves, roots and stem of *M. umbellatum* and lowest amount was present in inflorescence and no significant variation was found in fresh and in samples stored up to three years. The phytochemical screening of *M. umbellatum* was carried out and analysis revealed the presence of various phytoconstituents such as phytosterols, terpenoids, glycosides, tannins and flavonoids amino acids, carbohydrates, gum, resins, proteins and other phenolic groups. The extracts were subjected to chromatography in methanol: chloroform (1:9) v/v, which shows better separation of compounds and it is most distinct and clear in iodine vapour and UV light. This study provides promising results for the utilization of this plant as a formulation for the drug to treat diabetes after testing for clinical trials and further analysis. *M. terminale* plant extracts revealed the presence of significant levels of alkaloids and flavonoids, and moderate amounts of steroids, tannins, and phenols. Among the extracts, the methanolic extract of the plant contained a good percentage of phenolics. The methanolic extracts of leaves of 32 *Memecylon* species collected from the Western Ghats were evaluated for phytochemicals and pharmacological potential. Results showed that phenolic contents of the methanol extracts were comparatively low in *M. gracile* and *M. depressum* and flavonoid content was high in *M. grande* and lowest in *M. talbotianum*.

Anthocyanins reported from *Memecylon* species are Cy-3, 5-diglucoside from *M. amplexicaule* and Mv-3, 5-diglucoside from *M. caeruleum*. Phytochemical constituents from the aerial parts of *M. umbelletum* included β-

amyrin, sitosterol, oleanic acid, ursolic acid, sitosterol-β-D glucoside umbe lactone. Joshi *et al.* elucidated the structures of fatty acids such as octocosonoic acid, cerotic acid, ethyl palmitate, palmitic acid and butyric acid based on spectral data from the n-hexane extract of the roots of *M. umbellatum.*

The compounds which have been isolated from *Memecylon* species are known to possess several biological properties such as anti-inflammatory, antimicrobial, antidiabetic, antioxidant, anthelmintic anticancer, antiviral and multiple sclerosis properties which is used against several diseases.

Different solvent extracts of *M. umbellatum* stem were evaluated to determine the chemical constituents using GC-MS (Gas chromatography-Mass spectrophotometry) analysis. Totally, 20 different compounds from chloroform extract, 11 from petroleum ether extract and 10 from ethanol extract were identified. *M. umbellatum* leaf extract treated with green synthesized silver and gold nanoparticles and the effect of the phytochemicals present in *M. umbellatum*, including saponins, phenolic compounds, phytosterols, and quinones, on the formation of stable silver and gold nanoparticles was investigated by Fourier-transform infrared spectroscopy. The morphology and crystalline phase of the nanoparticles were determined by transmission electron microscopy and energy-dispersive x-ray spectroscopy. The results indicate that the saponins, phytosterols, and phenolic compounds present in the plant extract play a major role in the formation of silver and gold nanoparticles in their respective ions in solution. The characteristics of the nanoparticles formed suggest application of silver and gold nanoparticles as chemical sensors in the future.

The methanol extract of *M. edule* contained squalene, palmitic acid, and fatty acid as evident from GC-MS analysis and the related functional group was identified using FT-IR spectra. The GC-MS profile of ethyl acetate extract of *M. edule* showed 26 major compounds with different parentage of peak values. Among them, steric acid was the predominant (20.19%) constituent. The metabolite profiling of methanol extracts of *M. talbotianum* was subjected to UPLC-PDA-ESI/HDMS. Eighteen metabolites were identified, of which synapoyl-hexose-formic acid; kaempferol 3-*O*-feruloylhexosyl rhamnoside; 6-C-arabinosyl-8-C-glucosyl-apigenin and isorhamnetin-3-O-glycoside-7-O-glycoside were the main constituents.

In HPLC analysis, rutin, quercetin and protocatechuic acid were found to be the major components present in *M. talbotianum*. The presence of these compounds in this plant species is reported for the first time, and they could be responsible for the antidiabetic activity of *M. talbotianum*.

Each constituent explained separately: -

- ***Gallic acid: -***

It is also known as Trihydroxybenzoic acid, it is a type of phenolic acid; it is a group of hydrolysable tannins. It is used in pharmaceutical industries for various purposes.

Main sources of gallic acid: -

Tea, oak bark, strawberries, grapes, banana, clove, vinegar, gallnuts etc.

Basic pharmacokinetics of gallic acid: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of gallic acid: -

It is anti-viral, anti-fungal, anti-oxidant, prevents cancers of colon, prostrate, leukemia without harming healthy cells, prevents neural disorders, anti-inflammatory, asthma, allergy, rhinitis, sinusitis etc.

- ***Ferulic acid: -***

It is a hydroxycinnamic acid, an organic phenolic compound; it is antioxidant & used in skin care products, it reduces spots, wrinkles, it is anti-ageing, anti-hypertensive, anti-diabetic, helpful in cardiovascular diseases, Alzheimer's etc. It is mainly present in bran, oats, rice, eggplant, citrus, apple seeds etc. It is also known as 4-Hydroxy-3-methoxycinnamic acid.

- ***Protocatechuic acid: -***

It is a dihydroxybenzoic acid (a type of phenolic acid); it is structurally similar to gallic acid, caffeic acid, vanillic acid & syringic acid; it well known antioxidant, anti-inflammatory, anti-bacterial, anticancer, anti-ulcer, anti-ageing, antiviral, analgesic, protects liver, heart, brain & nerves; it is mainly present is green tea, bran & grains, almond, olive oil, star anise, plums, rosemary, Japanese ginko biloba.

- ***Oleanolic acid:-***

It is also called oleanic acid. It is naturally occurring pentacyclic triterpenoid recreated to betylinic acid. It is present in olive oil, marjoram, jujube, fruit peel, olive leave and olive fruit. It is anti-inflammatory, antioxidant, reduce lipids, anti-cancer, modulate immune response.

- ***Catechin: -***

It is a natural polyphenol; it is a plant secondary metabolite.

Main sources of catechin: -

It is mainly present in tea, cocoa, berries, apples, grapes seeds, kiwi, strawberries, green tea etc.

Basic clinical pharmacology of catechin: -

It is antioxidant, prevents cell damage, anti-inflammatory, anti-cancer, promotes heart & brain health and reduces blood pressure & weight.

- ***Luteolin: -***

It is a tetra-hydroxy flavone (flavonoids are polyphenolic compounds); a naturally occurring flavonoid

Main sources of luteolin: -

Celery seeds, thyme, green pepper, fenugreek seeds, broccoli, carrot, orange, basil etc.

Basic pharmacokinetics of luteolin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research.

Basic clinical pharmacology of luteolin: -

It is famous for activities like anti-oxidant, anti-inflammatory, apoptosis (inducing & chemo-preventive activities), reduces free radicals, oxidative stress, reduces tumour cell growth & suppresses metastasis & cancer growth.

- ***Quercetin: -***

It is a plant flavonol from the flavonoid group of polyphenols; it is bitter in taste.

Main sources of quercetin: -

Red onion, green tea, apples, ginko biloba, grapes etc.

Basic pharmacokinetics of quercetin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research.

Basic clinical pharmacology of quercetin: -

It is good for heart diseases, coronary heart disease, prevents cancer, arthritis, bladder infection, diabetes; it is anti-oxidant, anti-inflammatory, reduces benign prostatic hyperplasia, cholesterol, blood pressure, asthma, symptoms of rheumatoid arthritis.

- ***Kaempferol: -***

It is a natural flavonol (a type of flavonoid) it is tetra-hydroxy-flavone.

Main sources of kaempferol: -

Fenugreek seeds, green tea, grapes, tomato, broccoli, spinach, raspberries, peaches, green beans, onion, potato etc.

Basic pharmacokinetics of kaempferol (based on human intake in natural food products): -

It is ingested as a glycoside, absorbed in small intestines usually by passive diffusion; it is metabolized in various parts of the body. In small intestine it is metabolized to glucuronide & sulfo-conjugate by intestinal enzymes & it is also metabolized by colon micro-flora (bacteria) which can hydrolyze the glycosides to aglycones or form simple phenolic compounds. It is mainly metabolized in liver to glucurono-conjugated & sulfo-conjugated form. It is mainly excreted in urine.

Basic clinical pharmacology of kaempferol: -

It is anti-oxidant, anti-inflammatory, anti-microbial, anti-cancer, cardio protective, neuro microbial, anti-diabetes, estrogenic, analgesic, anxiolytic, anti-allergic, anti-viral etc.

- ***Rutin: -***

It is also called as Rutoside, it is a citrus flavonoid found in many plants including citrus fruits & it is soluble in water & alcohol.

Main sources of rutin: -

It is present in green tea, quince, apple, asparagus, black tea, citrus fruits, grapes, cherries, apricot, noni, leaves of eucalyptus, buck wheat, ginkgo biloba, raisins etc.

Basic pharmacokinetics of rutin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are in research.

Basic clinical pharmacology of rutin: -

It reduces high blood pressure, bleeding, bleeding piles, it strengthens the blood vessels, it reduces risk of cancers due to its anti-oxidant & anti-free radicals activity, reduces bruise, inflammation, protects heart, brain etc; it is chelator of metal ions.

- ***Isorhamnetin: -***

I*sorhamnetin* is the methylated metabolite of quercetin. Quercetin is an important dietary flavonoid with in vitro antioxidant activity. However, it is found in human plasma as conjugates with glucuronic acid, sulfate or methyl groups, with no significant amounts of free quercetin present.

- ***Apigenin: -***

It is a natural flavonoid compound found in many fruits & vegetables serves multiple physiological functions.

Main sources of apigenin: -

It is present in onion, oranges, wheat, tea, grapes, parsley, thyme.

Basic pharmacokinetics of apigenin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research.

Basic clinical pharmacology of apigenin: -

It calms the nerves, provides antioxidant effects, prevents & helps the body to fight cancer; it is anti-obesity; neuro-protective, help mood & brain function; reduces cortisol, blood sugar; improves bone, heart & skin health; promotes sleep. It is also anti-bacterial, anti-viral; reduces blood pressure.

- ***Butyric acid: -***

Natural butyric acid present in honey prevent mites & viral infections among the bees; it is also artificially used as a mite repellent in honey hive by honey harvester.

- ***Palmitic acid: -***

It makes up 7% to 13% of extra virgin olive oil; it is a common saturated fatty acid; it is the first fatty acid produced during lipogenesis (fatty acid synthesis) & from which longer fatty acids can be produced.

Main sources of palmitic acid: -

It is present in olive oil, flaxseed oil, soyabean oil, sunflower oil, palm oil, cocoa butter, meat, milk & etc.

Basic pharmacokinetics of palmitic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are under research.

Basic clinical pharmacology of palmitic acid: -

It softens the skin & keeps it moist thus good for psoriasis & eczema. It coats the skin, it is powerful anti-oxidant; it maintains the health of hair & skin from aging, cleans them from dirt, sweat, excessive sebum (main cause of acne and boil on face & other parts of the body).

- ***Ursolic acid (UA): -***

It is pentacyclic triterpenoid; it is widely present in peels of fruit, herbs like rosemary, thyme, vegetables, basil etc. It is anti-inflammatory, anti-oxidant, anti-apoptotic, anticancer. UA-associated compounds include oleanolic acid, betulinic acid, uvaol and α- and β-amyrin; UA has the molecular formula $C_{30}H_{48}O_3$, a molecular weight of 456.70032 g/mol and a melting point of 283–285°C. UA can be dissolved in methanol, pyridine and acetone, but is insoluble in water and petroleum ether; UA and its derivatives exhibit potent biological and pharmaceutical effects. The anti-inflammatory effect of UA was linked to attenuation of production of proinflammatory cytokines including tumor necrosis factor α, interleukin; U A was associated with suppression of the nuclear factor-κB (NF-κβ) pathway, inhibition of expression of cyclooxygenase-2 (COX-2) and nitric oxide synthase and the reduction of perhydrides including nitric oxide and hydrogen peroxide.

- ***Anthocyanin: -***

It is a type of flavonoid & is the pigments that give red, purple & blue plants their rich colouring.

Main sources of anthocyanin: -

Black soybean, pomegranate, black berries, cherries, grape, plums etc.

Basic pharmacokinetics of anthocyanin: -

Its absorption, metabolism & excretion are not known yet and are under research.

Basic clinical pharmacology of anthocyanin: -

It is a strong anti-oxidant, anti-cancer, anti-inflammatory, removes free radicals from the body, prevents heart diseases, blood pressure, infections, urinary infections, cough & cold.

- ***Tannin: -***

It is of astringent (dry & puckery feeling in mouth) taste, it is a polyphenol present in many plants, fruits, plant's wood, bark, leaves, skin, seeds etc. It is also called as Tannic acid; it is of 2 types hydrolysable & condensed.

Hydrolysable is decomposable in water & reacts with water & form other substance. Condensed form is insoluble & precipitates, it is called as tanner's reds. But most of tannic acid is water soluble.

Main sources of tannin: -

It is present berries, apple, barley, nut, tea, legumes, grapes, pomegranate, quince, oak wood, lemons, squash etc.

Basic pharmacokinetics of tannin (based on human intake in natural food products): -

Its absorption, metabolism & excretion are yet not known & are under research. After ingestion its bioavailability is poor due to its large size, high affinity to bound to plasma protein & low lipid solubility. It gets hydrolyzed in glucose & release gallic acid & other compounds upon decomposition.

Basic clinical pharmacology of tannin: -

It is used internally & externally. Externally it cures & heals the condition when applied on cold sores, fever blisters, diaper rashes, bleeding gums, tonsillitis, skin rashes, white discharge, yellow discharge, minor burn etc. It is used as douche for virginal disorders like white or yellow discharge.

In food it is used as flavoring agent & naturally present in fruits etc, it relieves & cures chronic diarrhea, dysentery, hematuria (blood in urine), pain in joints, persist cold, cancers etc, it reduces high blood pressure, high lipids in blood. It is anti-aging, anti-oxidant, anti-bacterial, anti-enzymatic. It is used in medicated ointments for piles.

If used excessive it can give toxic effects on skin & internally may reduce absorption of vitamin, cause stomach irritation, nausea, vomiting, liver damage, kidney damage. It should not be used in pregnancy, breast feeding & constipation.

- ***Triterpenes: -***

It is a natural group of plant product (saponins); it is of two types simple & complex, simple are components of surface waxes & specialized membranes & act as signaling molecules; complex are glycosylated & provide protection to the plant against pathogen & pests.

Main sources of Triterpenes: -

Olive oil, olive leaves, olive fruits, rosemary, cucumber, it is present in plant surface such as stem bark, leaf, fruit waxes of many plants speacially of Lamiaceae family.

Basic pharmacokinetics of Triterpenes (based on human intake in natural food products): -

Before absorption it is hydrolyzed by intestinal enzymes or by bacterial enzymes in large intestine and absorbed; it has low absorption rate; not much is known about its digestion.

Basic clinical pharmacology of Triterpenes: -

It is anti tumour, anti-viral, anti-bacterial, anti-oxidant, anti-diabetes, cardio protective, anti-obesity, anti-cancer, anti-ulcer, anti-inflammatory, immune-modulator, resolve immune diseases.

- ***Amyrin: -***

Amyrins are three closely related natural chemical compounds of the triterpene class. They are designated α-amyrin (ursane skeleton), β-amyrin (oleanane skeleton) and δ-amyrin. Each is a pentacyclic triterpenol. They are widely distributed in nature and have been isolated from a variety of plant sources such as epicuticular wax. In plant biosynthesis, α-amyrin is the precursor of ursolic acid and β-amyrin is the precursor of oleanolic acid. It is antinociceptive and anti-inflammatory.

- ***Beta-sitosterol: -***

It is among phytosterols & a main dietary phytosterol found in plants. It is anti-cancer, anti-inflammatory, it improves urine flow, reduces symptoms of heart diseases, reduces cholesterol, boost immune system, reliefs bronchitis, migraine, asthma, fatigue, rheumatoid arthritis, improve hair quality, reliefs prostrate problems, improves erectile dysfunctioning, psoriasis, libido.

Main sources of beta-sitosterol: -

Canola oil, avocados, almond, soya bean oil, nuts, vegetable oil, dark chocolate, rice bran oil, wheat germ, corn oil, peanuts etc.

- ***Malic acid: -***

It is a natural organic substance present in many fruits & plants; it is an alpha-hydroxyl acid (a natural acid) commonly used in skin care products & has many health benefits.

Main sources of malic acid: -

It is present in watermelon, quince, apricot, banana, grapes, quince, kiwi, orange, straw berries, mango, luchees, apple, pear, cherries, quince etc.

Basic pharmacokinetics of malic acid (based on human intake in natural food products): -

Its absorption, metabolism & excretion are not known yet & are under research.

Basic clinical pharmacology of malic acid: -

It is anti-aging, removes dead skin cells, treats acne, promotes skin hydration, improves complexion, boost sports performance, promotes energy production, increases exercise capacity, removes muscles fatigue, reduces muscular pain & muscle weakness, increases mineral absorption thus anti-arthritis, increases digestion, chelator of aluminum, it is also a body detox.

Malic acid has low pH of 3.33 & can aid in stomach digestion when the body does not produces naturally hydrochloric acid for digestion; it acts on quick absorption, helps the whole digestive system, softens the gall stones, dilates the bile duct & act on excretion of gall stones.

- ***Sinapic acid: -***

Sinapic acid (3,5-dimethoxy-4-hydroxycinnamic acid) is an orally bioavailable phytochemical, it is a small natural hydroxycinnamic acid, it is among phenyl-propanoid family; it is also called as sinapinic acid; it is mainly present in spices, citrus fruits, berry fruits, vegetables, cereals, seeds, oilseed crops; it is antioxidant, anti-inflammatory, anti-cancer, anti-glycemic, neuro-protective, antibacterial, anti-mutagenic. The literature reveals that sinapic acid is a bioactive phenolic acid and has the potential to attenuate various chemically induced toxicities.

- ***Cinnamic acid: -***

Cinnamic acid, also known as (Z)-cinnamate or 3-phenyl-acrylate, belongs to the class of organic compounds known as cinnamic acids. These are organic aromatic compounds containing benzene and a carboxylic acid group forming 3-phenylprop-2-enoic acid. It is obtained from oil of cinnamon, or from balsams such as storax. Cinnamic acid is a weakly acidic compound (based on its pKa). It is a white crystalline compound that is slightly soluble in water, and freely soluble in many organic solvents. Cinnamic acid exists in all living organisms, ranging from bacteria to humans. Outside of the human body, cinnamic acid has been detected, but not quantified in, Chinese cinnamons. This could make cinnamic acid a potential biomarker for the consumption of these foods. The original synthesis of cinnamic acid involves the Perkin reaction, which entails the base-catalyzed condensation of acetic anhydride and benzaldehyde. Cinnamic acid can dimerize in non-polar solvents resulting in different linear free energy relationships. Cinnamic acid is a central intermediate in the biosynthesis of myriad natural products include lignols (precursors to lignin and lignocellulose), flavonoids, isoflavonoids, coumarins, aurones, stilbenes, catechin, and phenylpropanoids.

- ***Octacosanoic acid: -***

Octacosanoic acid is a straight-chain saturated fatty acid that is octacosane in which one of the terminal methyl groups has been oxidised to the corresponding carboxy group. It has a role as a plant metabolite. It is a straight-chain saturated fatty acid and an ultra-long-chain fatty acid. It is a conjugate acid of an octacosanoate. Octacosanoic acid is a higher aliphatic primary acids purified from sugar-cane (Saccharum officinarum L.) wax that has been shown to inhibit platelet aggregation induced ex vivo by addition of agonists to platelet-rich plasma (PRP) of rats, guinea pigs, and healthy human volunteers.

- ***Cerotic acid: -***

Cerotic acid also called as hexacosanoic acid, is a 26-carbon long-chain saturated fatty acid with the chemical formula $CH_3(CH_2)_{24}COOH$. It is most commonly found in beeswax and carnauba wax, and is a white crystalline solid. Cerotic acid is also a type of very long chain fatty acid that is often associated with the disease adrenoleukodystrophy, which involves the excessive saturation of unmetabolized fatty acid chains, including cerotic acid, in the peroxisome.

- ***3-Feruloylquinic acid (3-FQA): -***

3-Feruloylquinic acid (3-FQA) belongs to the class of organic compounds known as quinic acids and derivatives. Quinic acids and derivatives are compounds containing a quinic acid moiety (or a derivative thereof), which is a cyclitol made up of a cyclohexane ring that bears four hydroxyl groups at positions 1,3.4, and 5, as well as a carboxylic acid at position 1. Coffee, especially green or raw coffee, is a major source of chlorogenic acids (CGA). CGAs have been associated with a range of health benefits including a reduction in the risk of cardiovascular disease, diabetes type 2, and Alzheimer's disease. Major CGAs in coffee include 3-, 4-, and 5-feruloylquinic acids. 3-FQA has been detected in the plasma and urine of

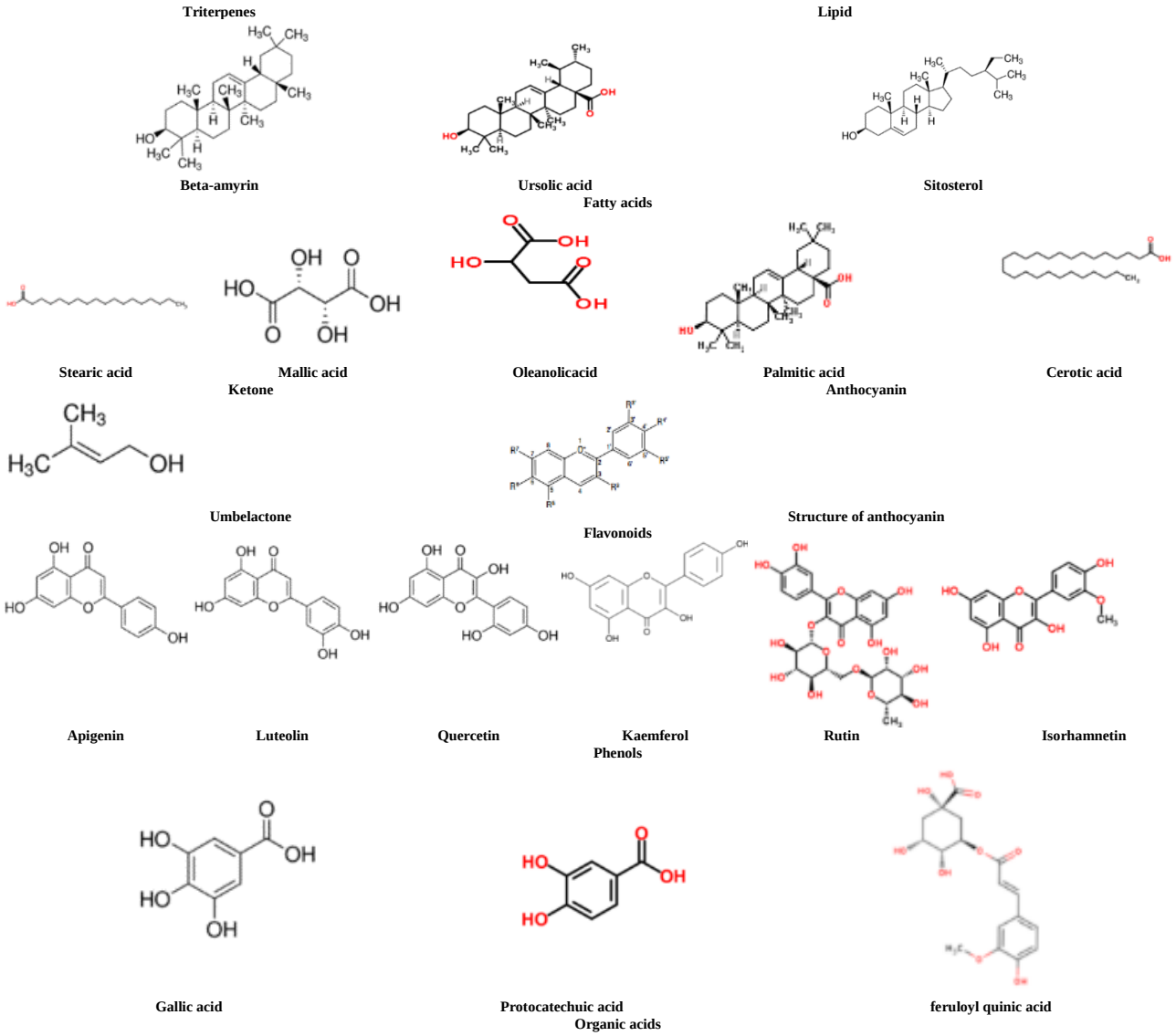
humans who ingested coffee. 3-FQA is also found in chicory, tomatoes (Lycopersicon esculentum), and sunflowers.

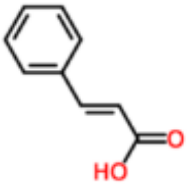
- ***L-Rhamnose (Rhamnoside): -***

L-Rhamnose is a deoxy sugar mainly found in gums and plant mucilages. It is one of the structural units of complex polysaccharides such as pectin and sterculia gum. L-Rhamnose may react with aqueous ammonia to form volatile flavor compounds such as alkyl pyrazines. Rhamnose occurs in nature in its L-form as L-rhamnose (6-deoxy-L-mannose). This is unusual, since most of the naturally occurring sugars are in D-form. Exceptions are the methyl pentoses L-fucose and L-rhamnose and the pentose L-arabinose. Rhamnose is commonly bound to other sugars in nature. It is a common glycone component of glycosides from many plants. Rhamnose is also a component of the outer cell membrane of acid-fast bacteria in the Mycobacterium genus, which includes the organism that causes tuberculosis.

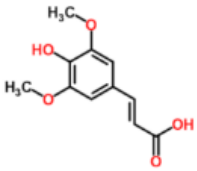
- ***Ethyl palmitate: -***

It is also known as Ethyl hexadecanoate is a long-chain fatty acid ethyl ester resulting from the formal condensation of the carboxy group of palmitic acid with the hydroxy group of ethanol. It has a role as a plant metabolite. It is a hexadecanoate ester and a long-chain fatty acid ethyl ester. It is present in various fruits like apricot, sour cherry, grapefruit, bilberry, guava fruit, melon, pineapple & also crispbread, clary sage, blackcurrant buds, rice bran etc.

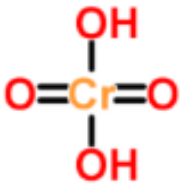




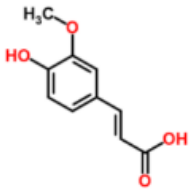
Cinnamic acid



Sinapic acid



Chromoic acid



Ferulic acid

- ***References: -***

"Melastomataceae.Net". www.melastomataceae.net. Archived from the original on 2007-07-15. Retrieved 2017-03-27.
^ Bremer, Kåre (1981). "Seeds and embryos in Sri Lanka (Ceylonese) species of Memecylon, with notes on Spathandra (Melastomataceae)". Nordic Journal of Botany. 1 (1): 62–65. doi:10.1111/j.1756-1051.1981.tb01036.x.
^ Jump up to:a b c d e f g Bremer, Kåre (1981-01-01). "Seeds and embryos in Sri Lanka (Ceylonese) species of Memecylon, with notes on Spathandra (Melastomataceae)". Nordic Journal of Botany. 1 (1): 62–65. doi:10.1111/j.1756-1051.1981.tb01036.x. ISSN 1756-1051.
^ Jump up to:a b c d "Memecylon".
^ Jump up to:a b c d Stone, Robert Douglas (2014-06-30). "The species-rich, paleotropical genus Memecylon (Melastomataceae): Molecular[phylogenetics and revised infrageneric classification of the African species". Taxon. 63 (3): 539–561. doi:10.12705/633.10.
^ Jump up to:a b c "A Field Guide to Economically Important Plants of Sri Lanka". www.nhbs.com. Retrieved 2017-03-30.
^ Jump up to:a b c d e f g h i Lafrankie, James V. (2010). Trees of tropical Asia : an illustrated guide to diversity / James V. LaFrankie, Jr. ; with illustrations by the author ; supplemented with photographs by other regional biologists. - Version details. Trove. ISBN 9789719479406. Retrieved 2017-04-21.
^ Jump up to:a b c d Stone, Robert Douglas (2012-07-06). "Endemism, species richness and morphological trends in Madagascan Memecylon (Melastomataceae)". Plant Ecology and Evolution. 145 (2): 145–151. doi:10.5091/plecevo.2012.545.
^ "Multiple Miocene Melastomataceae dispersal between Madagascar, Africa and India"(PDF).
^ Wijedasa, Lahiru S.; Hughes, Mark (2012-09-07). "A new species and new combinations of Memecylon in Thailand and Peninsular Malaysia". Phytotaxa. 66 (1): 6–12. doi:10.11646/phytotaxa.66.1.2. ISSN 1179-3163.
^ Hughes, Mark (2013-09-25). "Memecylon pseudomegacarpum M.Hughes (Melastomataceae), a new species of tree from Peninsular Malaysia". European Journal of Taxonomy. 0 (56). doi:10.5852/ejt.2013.56. ISSN 2118-9773.
^ Renner, Susanne S. (2004-10-29). "Multiple Miocene Melastomataceae dispersal between Madagascar, Africa and India". Philosophical Transactions of the Royal Society of London B: Biological Sciences. 359 (1450): 1485–1494. doi:10.1098/rstb.2004.1530. ISSN 0962-8436. PMC 1693440. PMID 15519967.
^ "Interfamilial relationships in Myrtales: molecular phylogeny and patterns of morphological evolution" (PDF). Archived from the original (PDF) on 2016-10-18.
^ Jump up to:a b c Clausing, G.; Renner, S. S. (2001-03-01). "Molecular phylogenetics of Melastomataceae and Memecylaceae: implications for character evolution". American Journal of Botany. 88 (3): 486–498. doi:10.2307/2657114. ISSN 0002-9122. JSTOR 2657114. PMID 11250827.
^ Stone, Robert Douglas (2006-01-01). "Phylogeny of Major Lineages in Melastomataceae, Subfamily Olisbeoideae: Utility of Nuclear Glyceraldehyde 3-Phosphate Dehydrogenase (GapC) Gene Sequences". Systematic Botany. 31 (1): 107–121. doi:10.1600/036364406775971741. JSTOR 25064133.
^ The Angiosperm Phylogeny Group (2016-05-01). "An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV". Botanical Journal of the Linnean Society. 181 (1): 1–20. doi:10.1111/boj.12385. ISSN 1095-8339.
^ "Ancestral Building Materials". malatumbaga.com. Retrieved 2017-04-21.
^ Jump up to:a b Satya, S; Vijayarani, KR; Srividhya, R; Gangatharan, N; Xavier, MF; Arunprasad, S; Kody, AP (2003). "Astringent activity of Memecylon". Anc Sci Life. 23 (2): 120–2. PMC 3330965. PMID 22557122.

- ***Research: -***

The leaf extracts of Memecylon umbellatum was screened for its antigenotoxic potency against cyclophosphamide induced chromosomal aberration and micronucleus formation. The result showed that the mice treated with alcoholic and aqueous extracts of M. umbellatum, had prevented the geno-toxicity of cyclophosphamide. The frequency of chromosomal aberration and micronucleus (MN) although not significant statistically, the percentage aberration and MN formation appeared to be dose and time dependent. There was a slight depression in the mitotic index compared to negative controls. The extracts were found to be non-mutagenic on bone marrow cells of mice. The anti-genocity studies are directly related to the protective role of the extracts on the genetic material.

The antispasmodic activity of the ethanol extract of the M. umbellatum roots were assessed in vitro using rat ileum. The results showed that the ethanol extract antagonize the acetylcholine induced contraction in a concentration dependent manner. The plant extract at a concentration of 50, 100, and 200 mg exhibited 14.28, 18.75, 37.5% inhibition respectively, against acetylcholine induced contraction in isolated rat ileum preparation. The antispasmodic activity may be due to its cholinergic system blockade. The present study reveals that the extract antagonizes the contraction in ileum stimulated by acetylcholine, indicates that the extract shows atropine like action2.

The ethanolic extract of the roots of Memecylon umbellatum was evaluated using acute rat model by carrageenan induced rat paw oedema and a sub-acute rat model by cotton pellect induced granuloma. The ethanolic extract showed significant anti-inflammatory activity in both the animal models, and the weight of adrenal glands were also found to be significantly increased in extract treated animals. The results indicate the dose dependent anti-inflammatory activity of the roots of Memecylon umbellatum in the acute carrageenan-induced rat paw oedema and the sub-acute granuloma pouch models2.

- ***Conclusion: -***

In India the genus *Memecylon* is represented by about 40 species, out of which 21 species are endemics. Taxonomic status of the Indian *Memecylon* species is not clear owing to complexity in their morphology. Molecular biology offers different techniques to solve taxonomical confusions. However, molecular work has not been conducted on Indian *Memecylon* species. Therefore, molecular studies should be conducted on Indian *Memecylon* species to resolve their taxonomical and nomenclatural problems. *Memecylon* species have shown potential pharmacological activities such as anti-inflammatory, antidiabetic, antiviral, hepatoprotective, antimicrobial and antioxidant activity. Few studies have revealed the compounds responsible for these bioactivities. However, exact mechanism of action of bioactive compounds from *Memecylon* species is not known. If future studies throw a light on these aspects, definitely it will help in developing a potential biopharmaceutical product. In addition *Memecylon* species show great promise in developing a drug to cure herpes and other skin ailments.

Natural product market is growing tremendously in last few years. The plant iron wood tree (Memecylon umbellatum) had a long history of traditional uses for wide range of diseases. It has been proved that various parts of the plant were used in traditional to treat various ailments. In recent years it has been experimentally proved that the plant possess analgesic, anti-inflammatory, wound healing, hypoglycemic, antimicrobial, anti-spasmodic, nephroprotective and hepatoprotective activity. Further studies need to be carried out to explore its potential in curing disease by using isolated compound.

In India, the genus Memecylon is represented by about 40 species, out of which 21 species are endemics. Taxonomic status of the Indian Memecylon species is not clear owing to complexity in their morphology. Molecular biology and protein profiling offers different techniques to solve taxonomical confusions or problems. However, molecular work and protein profiling has not been conducted on Indian Memecylon species. Therefore, the present study deals with molecular studies mainly DNA barcoding and protein profiling analysis on Indian Memecylon species to resolve their taxonomical and nomenclatural problems. Also very few compounds are identified from M. umbellatum other species are not screened for metabolite analysis hence metabolite profiling studies are taken up in the present study which may also help in species authentication. Memecylon species have shown potential pharmacological activities such as anti-inflammatory, antidiabetic, hepatoprotective and antioxidant activity. Memecylon species show great promise in developing a drug to cure herpes and other skin ailments. However, the scientific evidence to prove its pharmaceutical potential is still not available. It is essential to establish the chemical moiety of Memecylon species to study the mechanism of action. Few studies have revealed the compounds responsible for these bioactivities. However the exact mechanism of action of bioactive compounds from Memecylon species is not known. Hence, bioactive potential of Memecylon species namely M. umbellatum, M. talbotianum, M. edule, M. malabaricum and M. wightii has been taken up in the present study.